Having thus described the preferred embodiments, the invention is now claimed to be:

1. A method of forming a composite material comprising:

combining a reinforcement material which includes carbon-containing fibers with a carbonizable matrix material to form a mixture;

heating the mixture to a sufficient temperature to melt at least a portion of the matrix material and remove at least a portion of volatile components from the matrix material, the step of heating including:

applying an electric current to the mixture to generate heat within the mixture; and

while heating the mixture, applying a pressure of at least 35 $kg/cm^2$ to the mixture to form a compressed composite material.

2. The method of claim 1, wherein the step of heating and applying pressure comprises heating the mixture to a temperature of at least 500°C to form a compressed composite material having a density of at least 1.3 $g/cm^3$ within thirty minutes.

3. The method of claim 1, wherein the step of heating includes heating to a temperature of about 800°C and wherein the compressed composite formed in the step of heating while applying a pressure has a density of at least 1.4 $g/cm^3$.

4. The method of claim 1, wherein the carbon-containing fibers are derived from precursors selected from the group consisting of carbonized rayon, cotton, polyacrylonitrile, polyacetylene, cellulose, pitch, and combinations thereof.

5. The method of claim 4, wherein the carbon-containing fibers include at least one of mesophase pitch carbon fibers and polyacrylonitrile carbon fibers.

6. The method of claim 1, wherein the matrix material is selected from the group consisting of phenolic resins, furan resins, coal tar pitch, petroleum pitch, and combinations thereof.

7. The method of claim 1, wherein the matrix material has a carbon yield of at least 50%.

8. The method of claim 6, wherein the matrix material comprises finely divided pitch.

9. The method of claim 1, wherein the step of heating comprises:

heating the mixture for a first period of time at a first temperature by applying a first power level; and

heating the mixture for a second period of time at a second temperature higher than the first temperature by applying a second power level higher than the first power level.

10. The method of claim 9 wherein the first power level is about 30kW/kg and the second power level is from about 45 to about 60kW/kg.

11. The method of claim 9, wherein the first temperature is in the range of from about 300°C to about 500°C and the second temperature is in the range of from about 800 to about 900°C.

12. The method of claim 9, wherein the pressure applied to the mixture in the first period of time is from about 35 kg/cm$^2$ to about 70 kg/cm$^2$ and the pressure applied to the mixture in the second period of time is at least about 100 kg/cm$^2$.

13. The method of claim 1, wherein the step of combining comprises combining about 50-80% by weight carbon-containing fibers with about 50-20% by weight carbonizable matrix material.

14. The method of claim 12, wherein the step of combining comprises combining about three parts by weight carbon-containing fibers with about one part by weight carbonizable matrix material.

15. The method of claim 11, wherein the step of combining the carbon-containing fibers and carbonizable matrix material comprises heating the carbonizable matrix material to a temperature above its melting point.

16. The method of claim 13, wherein the step of combining the carbon-containing fibers and carbonizable matrix material comprises dry mixing the matrix material and carbon-containing fibers in a blender without addition of solvent.

17. The method of claim 1, wherein the pressure is applied to the mixture in a direction in which the current is applied.

18. The method of claim 15, wherein the pressure is applied by first and second electrically conductive members, the step of applying an electric current to the mixture including forming an electrical conduction path between the mixture and the electrically conductive members.

19. The method of claim 1, further comprising:

increasing the density of the compressed composite by introducing a carbonizable material into voids in the compressed composite and then baking the compressed composite to achieve a density of at least 1.6 g/cm$^3$.

20. The method of claim 1, further comprising:

graphitizing the compressed composite in an inert atmosphere to a final temperature of at least 1500°C.

21. The method of claim 1, wherein the step of heating includes converting the matrix material to an infusible material.

22. An apparatus for forming a compressed composite material comprising:

a vessel which defines a cavity for receiving a material to be treated;

a means for applying pressure which applies a pressure of at least 35 $kg/cm^2$ to the material in the cavity;

a source of electrical current which applies a current to the material, the current flowing through the material to resistively heat the material;

a temperature detector which detects the temperature of the material; and

a control system which controls the pressure applying means and source of electrical current such that the mixture is sequentially heated at a first temperature and pressed at a first pressure for a first period of time, and heated at a second temperature higher than the first temperature and pressed at a second pressure higher than the first pressure for a second period of time.

23. A method of forming a composite material suitable for vehicle brakes comprising the steps of:

a) compressing a mixture of carbon fibers and a matrix material which includes pitch;

b) during the step of compressing, applying a current to the mixture, the mixture providing a sufficient electrical resistance to the current such that the mixture reaches a temperature of at least 500°C to drive off volatile components of the mixture and form a compressed preform;

c) introducing a carbonizable material into the compressed preform to form an impregnated preform;

d) optionally, baking the product of step c) to carbonize the carbonizable material;

e) optionally repeating step c) and step d); and

f) graphitizing the impregnated preform to a final temperature of from about 1500°C to about 3200°C to form the composite material, the graphitized preform having a density of at least 1.7 $g/cm^3$ if step c) is repeated no more than once.